PATENT SPECIFICATION

DRAWINGS ATTACHED

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1,010,721

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Date of Application and filing Complete Specification Oct. 20, 1964.

No. 42670/64.

Complete Specification Published Nov. 24, 1965.

Index at acceptance:—F2 V(L4C, L6C, L8C)

Int. Cl.:—F 06 k

COMPLETE SPECIFICATION

Improvements in Valves for Controlling the Flow of Fluids

We, AKTIEBOLAGET THULINVERKEN, of Landskrona, Sweden, a Swedish body corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a valve for controlling the flow of a fluid, comprising a valve housing with inlet and outlet passages, a valve seat in the housing, a movable valve member arranged to move quickly between a fully-open position and a fully-closed position in which it rests against the valve seat and separates an inlet chamber from an outlet chamber in the housing, the valve member being spring-loaded towards the valve seat and connected to a flexible wall partly bounding the inlet chamber so that fluid pressure in the inlet chamber tends to move the valve member away from the valve seat, and a movable push member arranged for opening the valve by pushing the valve member off the valve seat and connected to a flexible wall partly bounding the outlet chamber so that fluid pressure in the outlet chamber tends to move the push member away from the valve member.

According to the invention such a valve is characterised by an arrangement such that when the valve is in the closed position the effective area of the flexible wall connected to the push member is smaller than the effective area of the valve member encircled by the valve seat, and that when the push member contacts the valve member it does so around an area which is smaller than that area of the valve member which is encircled by the valve seat when the valve member is in contact with the valve seat. For opening the valve the push member may be moved by force due to the pressure of a variable pressure control fluid or by force exerted through a spring or other resilient means. Further and optional features of the invention appear from the following description and the appended claims.

In the accompanying drawings two valves in accordance with the invention are illustrated by way of example in diagrammatic sectional elevations,

Figs. 1 and 2 representing the first valve in its closed and open positions respectively, and

Fig. 3 representing the second valve in its closed position.

The valve illustrated in Figs. 1 and 2 comprises a valve housing 1 with an inlet passage 3 and an outlet passage 4. In the housing 1 is a valve seat 2. A movable valve member 5 is arranged to move quickly between a fully-open position (Fig. 2) and a fully-closed position (Fig. 1) in which it rests against the valve seat 2 and separates an inlet chamber 18 from an outlet chamber 19 in the housing 1.

The valve member 5 is spring-loaded towards the valve seat 2 by a compression spring 17 and is connected to a flexible wall 6 partly bounding the inlet chamber 18 so that fluid pressure in the inlet chamber tends to move the valve member 5 away from the valve seat 2.

A movable push member 9 is arranged for opening the valve by pushing the valve member 5 off the valve seat 2. This push member 9 comprises a stem with a disc having a rim 14 for contacting the valve member 5. The stem of the push member 9 extends through an opening 10 into an upper housing 11. The push member 9 is spring-loaded in a direction away from the valve member 5 by a compression spring 12 which bears against the top of the housing 1 and against a spring abutment 13 held on the stem of the push member 9. Upward movement of the push member 9 is limited by the upper housing 11.

[*Price* 4*s*. 6*d*.]

The push member 9 is connected to a flexible wall 7 partly bounding the outlet chamber 19 so that fluid pressure in the outlet chamber tends to move the push member 9 away from the valve member 5.

For opening the valve the push member 9 is moved by force due to the pressure of a variable pressure control fluid admitted through a passage 8 in the housing 1 for exerting pressure upon the flexible wall 7 connected to the push member 9.

The valve member 5 has a passage in the form of a central hole 15 opening within that area of the valve member 5 which is encircled by the rim 14 of the push member 9 when the latter contacts the valve member 5. The housing 1 has a passage in the form of a central hole 16 open to the atmosphere and to a chamber partly bounded by the valve member 5.

In the closed position of the valve shown in Fig. 1 the chamber 18 is limited mainly by the housing 1 and the flexible wall 6, whereas the chamber 19 is limited by the housing 1, the flexible wall 7 and the valve member 5.

The valve is kept closed in the position shown in Fig. 1 by the spring 17. The pressure of the fluid in the chamber 18 provides a force on the flexible wall 6 in the downward direction. The said flexible wall 6 has a certain effective area which is defined by its effective diameter D_2 as well as the diameter D_1 of the valve seat 2. Upon sufficient increase in the pressure of the variable pressure control fluid in the chamber above the flexible wall 7 the push member 9 will be depressed against the action of the spring 12 and the rim 14 having a diameter D_3 will engage the valve member 5. After further sufficient increase of the pressure in the control fluid the force of the springs 12 and 17 will be overcome, the push member 9 will be further depressed and will move the valve member 5 away from the valve seat 2. The valve is now open and the parts are in the positions shown in Fig. 2.

Assuming that the pressure in the chambers 18 and 19 is substantially equal after the opening of the valve and substantially equal to the pressure existing in the chamber 18 prior to the opening of the valve, and that the pressure in the chamber 19 is atmospheric prior to the opening of the valve, the following forces are exerted on the valve member 5 (the forces being counted positive in the downward direction) just prior to the valve opening:

$$k_1+k_2\ (D_2^2-D_1^2)-k_3$$

and just after the valve opening: $k_1+k_2\ (D_2^2-D_4^2)-K_3$ where K_1 is a constant and results from the force of spring 12 and from the control fluid pressure, k_2 is a constant and proportional to the pressure of the fluid in the chamber 19, and k_3 is a constant and depends on the force from the spring 17.

The effective diameter D_4 of the flexible wall 7 is relatively small because the circumference of the wall 7 is secured to the housing 1, and as this effective diameter D_4 is smaller than D_1 the resultant downward force on the valve member 5 just after the valve opening is greater than just prior to the valve opening and thus the initial opening of the valve leads to rapid complete opening of the valve.

During the closing of the valve owing to a decrease in pressure of the control fluid, the push member 9 is displaced upwards until the valve member 5 engages the valve seat 2. During the further upwards movement of the member 9 the rim portion 14 leaves the valve member 5 whereupon the chamber 19 is vented to atmosphere through the holes 15 and 16.

Just prior to the venting of the outlet chamber 19 the fluid pressure in this chamber 19 acts upon the push member 9 with a downwardly directed force.

$$k_2\ (D_3^2-D_4^2)$$

and after the venting the said force has disappeared. Thus the tendency to close will be increased because D_3 is greater than D_4.

Thus it can be seen that the arrangement is such that when the valve is in the closed position (Fig. 1) the effective area of the flexible wall 7 connected to the push member 9 is smaller than the effective area of the valve member 5 which is encircled by the valve seat 2, in the ratio $D_4^2:D_1^2$. When the push member 9 contacts the valve member 5

it does so around an area $\left(\frac{\pi}{4}D_3^2\right)$ which is

smaller than that area $\left(\frac{\pi}{4}D_1^2\right)$ which is encircled by the valve seat 2 when the valve member 5 is in contact with the valve seat 2.

Fig. 3 illustrates a valve which is similar in many respects to that illustrated in Figs. 1 and 2 but is modified for manual control, there being no passage in the valve housing for control fluid. Figure 3 represents a valve in which the push member 9 has its spring abutment 13 between two compression springs 20 and 21. The spring 21 bears against a sleeve 22 mounted slidably in the upper housing 11 and provided with a shoulder 23 to engage a shoulder 24 in the housing 11. An eccentric disc 25 can be turned by a handle 26 for pressing down the sleeve 22 and compressing the spring 21 and thereby exerting force to move the push member 9 for opening the valve. This valve functions in the same way as the valve shown in Figs. 1 and 2 (except that the opening force on the member 9 is exerted through the spring 21 instead of by pressure of control fluid) and thus will always assume a fully-open or fully-closed

position even if the handle 26 is in an intermediate position.

It will be readily understood that various modifications may be introduced without departing from the invention as defined in the appended claims, for example the eccentric 25 (Fig. 3) may be rotated automatically instead of by manual force.

The invention may thus be applied to provide an automatically-operated valve or a manually-operated valve. The valve may be designed for example to open completely upon the attainment of a particular pressure in a variable pressure control fluid, or to be manually-operated and to open suddenly and to be either fully-open or fully-closed even if the manual operation is performed slowly or incompletely.

WHAT WE CLAIM IS:—

1. A valve for controlling the flow of a fluid, comprising a valve housing with inlet and outlet passages, a valve seat in the housing, a movable valve member arranged to move quickly between a fully-open position and a fully-closed position in which it rests against the valve seat and separates an inlet chamber from an outlet chamber in the housing, the valve member being spring-loaded towards the valve seat and connected to a flexible wall partly bounding the inlet chamber so that fluid pressure in the inlet chamber tends to move the valve member away from the valve seat, and a movable push member arranged for opening the valve by pushing the valve member off the valve seat and connected to a flexible wall partly bounding the outlet chamber so that fluid pressure in the outlet chamber tends to move the push member away from the valve member, characterised by an arrangement such that when the valve is in the closed position the effective area of the flexible wall connected to the push member is smaller than the effective area of the valve member encircled by the valve seat, and that when the push member contacts the valve member it does so around an area which is smaller than that area of the valve member which is encircled by the valve seat when the valve member is in contact with the valve seat.

2. A valve according to claim 1, wherein for opening the valve the push member is moved by force due to the pressure of a variable pressure control fluid.

3. A valve according to claim 2, wherein the pressure of the control fluid for opening the valve is exerted upon the flexible wall connected to the push member.

4. A valve according to claim 1, wherein for opening the valve the push member is moved by force exerted through a spring or other resilient means.

5. A valve according to claim 1, 2, 3, or 4, wherein the valve member has a passage opening within that area of the valve member which is encircled by the push member when the latter contacts the valve member.

6. A valve according to claim 1, 2, 3, 4, or 5, wherein the valve housing has a passage open to the atmosphere and to a chamber partly bounded by the valve member.

7. A valve according to any of the preceding claims, wherein the push member is spring-loaded in a direction away from the valve member.

8. A valve constructed and arranged substantially as hereinbefore described with reference to and as shown in Figures 1 and 2 or Figure 3 of the accompanying drawings.

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32, Lodge Lane,
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Leamington Spa: Printed for Her Majesty's Stationery Office by the Courier Press.—1965.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

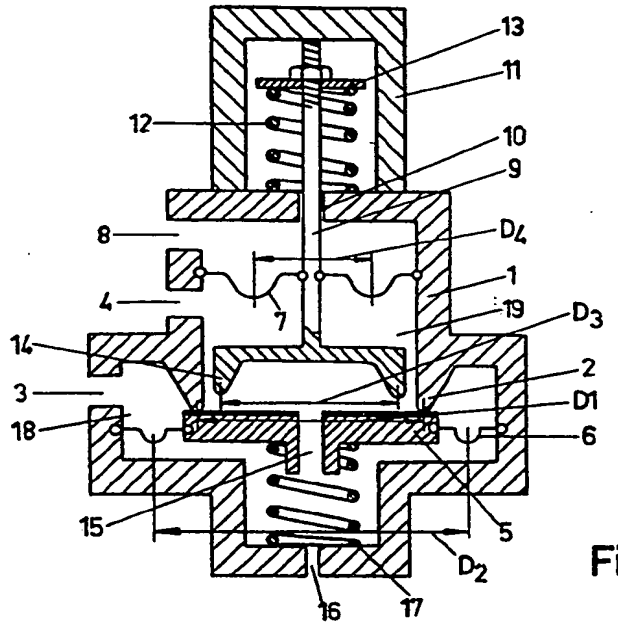

Fig.1

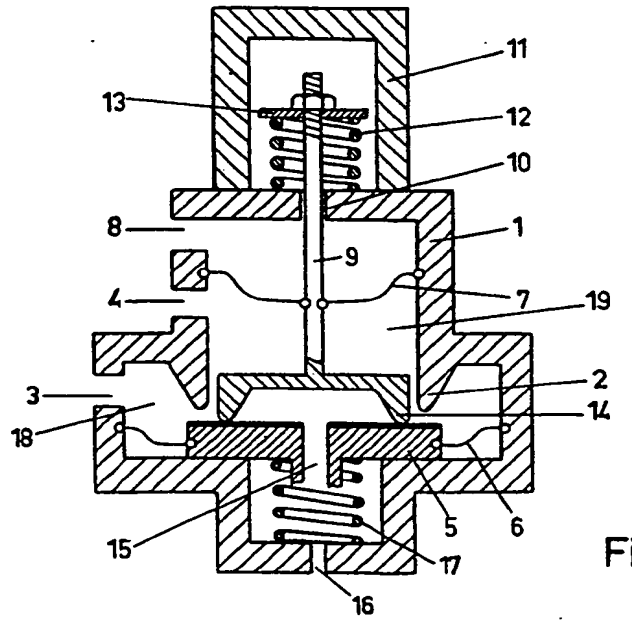

Fig.2

1,010,721 COMPLETE SPECIFICATION
2 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

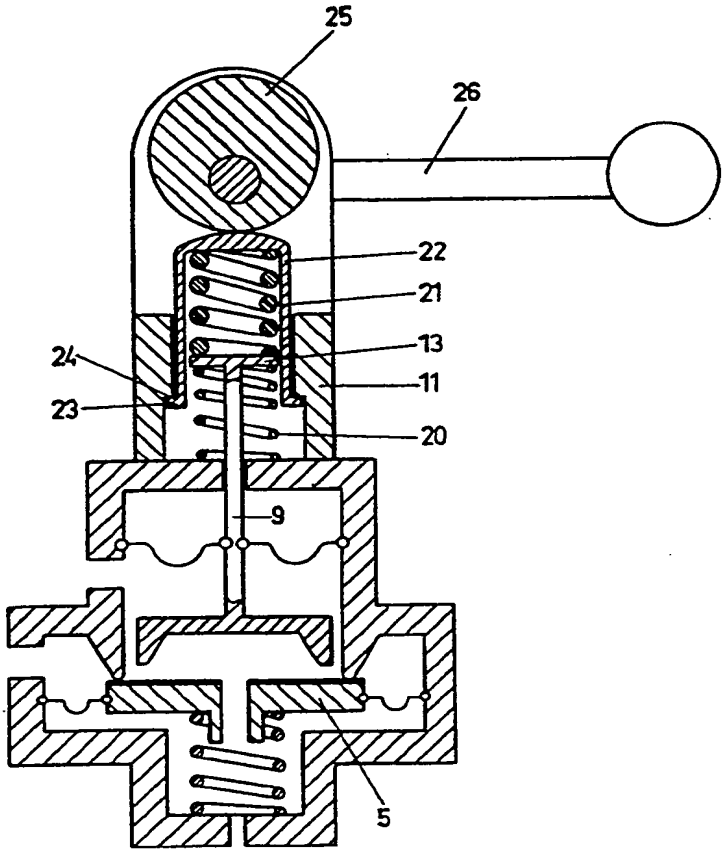

Fig.3

1,010,721 COMPLETE SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

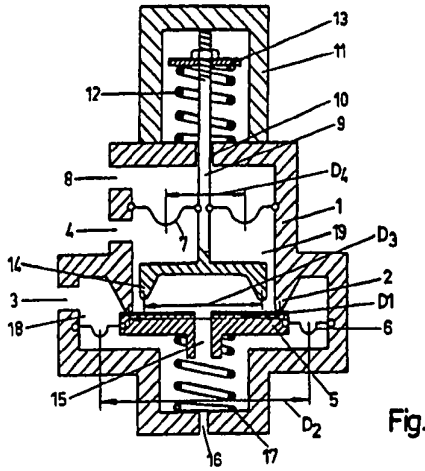

Fig.1

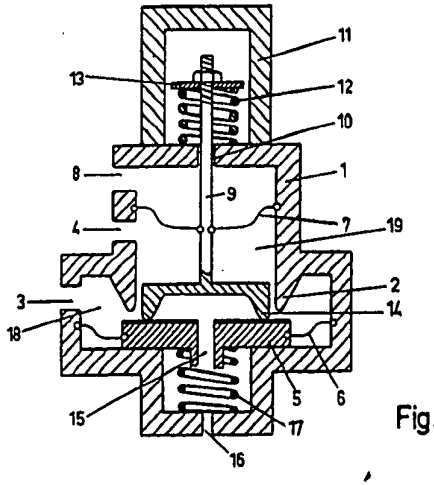

Fig.2

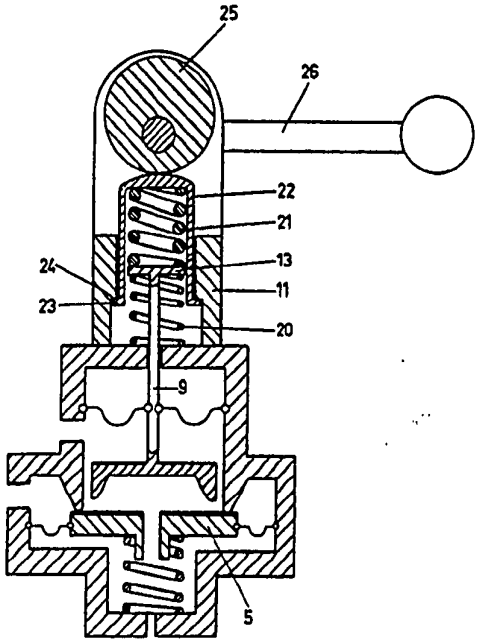

Fig.3